DOCUMENT RESUME

ED 256 516 PS 015 140

AUTHOR Vartuli, Sue; And Others
TITLE Research on Using Computers with Preschool-age Children.
PUB DATE [84]
NOTE 14p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Age Differences; *Learning Activities; *Microcomputers; *Preschool Children; Preschool Education; Sex Differences; *Success; *Teacher Role

ABSTRACT

Twenty-two 3-year-olds, 36 4-year-olds, and eight 5-year-olds were given the option of using two computers with selected, sequenced software games as one of their free-choice or work time activities. During the last half of the 33-week long study, children were also introduced to a floor turtle robot, a standing robot, and to Logo activities. Children's "computer success" was measured in terms of hardware use, software use, program interest, and robot use and simple Logo langauge programming skills. Most of the children were successful in the first three categories, representing those types of microcomputer activities most common in preschool classrooms. The data further indicated that females score higher overall on computer competency and interest than males do, while males score somewhat higher than females on performing robot tasks. Observational data also were collected on possible limitations and benefits of using microcomputers with young children. Benefits include familiarizing children with the technological world that they will know as adults, individualization of learning experiences, provision of immediate feedback, and the motivation of parental interest in the program. Computer use with preschoolers also decreases interaction between and among students, places considerable demands on teachers' time, and requires considerable prompting behavior of teachers. (RH)

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Research on Using Computers with Preschool-age Children

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Authors:

Sue Vartuli Ph.D.

Shirley Hill Ph.D.

Kathy Loncar

Nancy Caccamo

Research on Using Computers
with Preschool-Age Children

Are computers being used in preschool classrooms today without thoughtful consideration of, or evidence about, values and benefits to young children? In a thirty-two week research project, two researchers explored these issues, hoping to provide some answers to the growing questions on preschool computer use.

One basic question of this research study was to determine if three, four and five-year-old children were able to benefit from microcomputer experiences. For the study, the researchers operationalized "computer success" for preschool children by using four categories: 1) hardware use, 2) software use, 3) program interest, and 4) robot use and simple Logo language programming skills. In this report, data concerning computer success for the fifty-nine subjects are shared and the researchers' observations of the values and limitations of microcomputers for young children are reviewed.

The study took place at St. Peter's Early Childhood Education Center in Kansas City, Missouri. Sixty-six children attended this modified Montessori preschool for two, three, or five half-day sessions per week from October 1983 to May, 1984. Twenty-two three-year-olds, thirty-six four-year-olds, and eight five-year-olds were given the option of using the two computers with selected, sequenced software games as one of their free-choice or work time activities. During the last half of the study, the children were also introduced to a floor turtle robot, standing robot and to Logo activities. Because seven of the sixty-six children enrolled late in the year, data collected for these children were not included in this study in determining the overall success of computer use.

Computer Success

Four categories determined the successful use of computers by preschool children. The first category, hardware use, measured children's ability to handle computer software and hardware correctly. Children were rated on whether they could 1) push a single key after two sessions, 2) turn the computer and monitor off and on after three sessions, 3) push a key on command after two examples, and 4) load a disk correctly after one month.

All of the four-and-five-year-old children achieved the maximum in alloted points in the first category. Eighty-nine percent, or all but two, of the three-year-olds could motorically use the computer successfully with supervision. Thus, young children in this study did not seem to have any difficulty with manipulating the disks or with using the keyboard.

The second category, software use, measured the children's ability to follow game directions and to identify verbally the on-screen results of their keyboard input. The children were rated on their ability to follow directions and to accomplish their tasks within given time frames. Data were also recorded on whether the children verbally identified their actions for each computer session. All but nine of the children received the maximum number of points for this category, with no significant age or sex differences in scores. Most of the children who did not receive the maximum number of points in this category were identified by the classroom teacher either as immature in their speech patterns or as nonverbal children.

Data were recorded for category three, program interest, to ascertain how often children voluntarily selected the computer during the time they attended school and how much of the alloted time they spent actively

involved with the equipment. There was a definite sex and age trend within this category. (See Chart 1 and Graph 1.) The four-and five-year old females in the study participated significantly more often and for longer periods of time than the four-and-five year-old males. Also the five-year old males took fewer turns and used less of their alloted time than the three-or-four-year-old males. The five-year-old males seemed to lose interest in the computer after a few weeks. Seemingly, because the leader of the five-year-old male group chose to play in another interest area, the other boys followed his lead until the researchers observed the social interactions and allowed more than one child at the computer at a given time. The children responded positively to the fact that they could work with a friend. The five-year-old boys selected friends to join them at the computer (mean, 74%). The males selected more friends more frequently than the females at all age levels.

The fourth category related to children's ability to control a robot and a screen turtle through keyboard commands. There were twenty-five different tasks in controlling the movements of the robot. For example, a specific masking tape course was plotted on the floor for children to follow by selecting keys on the keyboard. Maneuvering the robot to a given location and knocking down a tower of blocks were among the designed tasks. At a later stage, children directed the screen turtle on predetermined paths, constructed given shapes, and participated in guided and carefully sequenced rudimentary programming tasks. For this fourth category, the data favored the older males. The older the boys, the more successful they were in this category. (See Chart 2.) Girls did not follow this trend. Three-and-five-year-old girls were not as successful as the four-year-old girls. (See Graph 2.) Only ten children received the

maximum number of points in this category.

Most of the children were successful in the first three categories, the types of microcomputer activities which most young children are involved with in preschool classrooms. The data indicated that females score higher overall on computer competency and interest than males, while males score somewhat higher than females on perforiming robot tasks.

Over the thirty-two weeks, the researchers also collected observational data on possible limitations and benefits of using microcomputers with young children. The next section addresses these points.

Benefits and Limitations of Using Computers with Young Children

One of the major benefits of using computers with young children is that children become familiar with the technological world that they will know as adults. Through early experiences with computers, children become aware of what machines can and cannot do; they gain a sense of power, self-confidence, and self-worth as they make machines work.

A typical comment from child participants was, "I made it do that!" Computers can, if properly used, generate and motivate interest in children. At the beginning of this study, the children's interest in using computer was very high. The children enjoyed the novel equipment and sought out the individual contact they had with the adult who guided their activities. As the study progressed the older male children used the computer less frequently and chose to play in other interest areas. Allowing the children to work in small groups often renewed interest in the computer. The social value of the activity was of primary importance, especially to the boys. It should be noted, too, that the computer can

decrease interaction between and among students because verbalization relates almost exclusively to the images on the screen, as evidenced by the following excerpt from a computer session with a three-year-old girl.

Teacher: "Press any letter. These are letters. These are numbers. Press these down here." (indicating letters.)

Child: "J" (Pressed key.)

Teacher: "Do you know what this is?

Child: "Throwing balls."

Teacher: "J is for juggling."

Child: (Presses key) "Airplane"

Teacher: "Helicopter. It is a special kind of airplane."

Child: (Presses key) "O"

Teacher: "What happened? Do you know what that is? Have you ever seen an octopus?

Child: (Watches other children at play)

Teacher: "Do you want to press another one?"

Child: (Presses key)

Teacher: "Do you know what that is?"

Child: "Yo-Yo."

Teacher: "Does Andy have a yo-yo?"

Child: "yes."

Session continues.

Using computers in a preschool classroom places heavy time demands upon a teacher if the computer experiences are meaningful to children. As the preceding excerpt indicates, a teacher must be present to give

directions, as well as to clarify and interpret what a child is seeing on the screen. A teacher must take sufficient time, not only to learn how to operate a computer but also to select, review, sequence, and relate software games to classroom objectives. Additional time is involved in teaching a child to operate the computer, with several sessions required to develop the needed, simple operational skills. For example, some three-year-olds still needed reminders toward the end of the project to be gentle when inserting the disk into the disk drive. To insure maximum effectiveness of computer use, teachers must invest whatever time is needed to keep adequate records. The computer can help a teacher observe and verify a child's progress in learning certain new concepts. By observing the child using the computer, a teacher can gain insights from another perspective which help in understanding the total child. For instance, some of the children in this study who were not as active in other regular preschool activities seemed to excel and thrive on this new computer experience.

If a teacher can do simple programming, computer sessions can be individualized for each child and can be adapted for all age and ability groups. Thus, learning can be paced to fit a particular child's learning rate. Most of the commercial software for preschoolers, however, is developed for a passive rather than an active learning mode, and much of it seems to minimize thinking skills and oral language abilities. Since young children learn best with active, hands-on, experimental learning, computers with current software should be viewed as only one among many tools and materials in preschool classrooms. Decisions to use computers also should take into account the need for significant expenditures of adult time in order to make experiences meaningful ones, not just activities to occupy a

child's time.

Some authors (Burg, 1983; Kimmel, 1982; Brady and Hill, 1983) have pointed out that a child should be at the concrete operational level of cognitive development to use a computer meaningfully. The thinking and problem solving which are required in some software packages for older children are rarely in evidence in preschool software. Preschool software encourages more trial and error responses. The following excerpt from a computer session with a three-year-old male relates to this point. It is apparent that much guessing and prompting were needed for this child to be successful. The child was expected to find letters on the keyboard that matched those on the monitor. This child's confusion between letters and numbers was obvious.

> Child: (Waits for game to appear on screen, turns around in chair, looks at photos on wall.) "Who is that?" (Indicating a picture.)
>
> Teacher: (Gives instructions). "Press 5."
>
> Child: (Presses 5, finds 5 key on keyboard presses 5.)
>
> Teacher: "Very good." (Prompts child when next letter comes up on screen.) "Look in the bottom row."
>
> Child: "Where is it? Here?"
>
> Teacher: "You knew it. Good job, (Child's name)."
>
> Child: "Which number is that?" (Presses key.)
>
> Teacher: "Good job finding the <u>letters</u> on the keyboard."
>
> Child: "That number keeps coming up again."

(looks for key.)

Teacher: (Prompts) "Bottom row."

Child: "Yah!" (claps) "Is that the one?"

Teacher: "Yes." (helps child find W key by prompting).

Child: "I know where that one is." (puts finger in mouth, studies keyboard, turns to teacher.) "Where?"

Teacher: "Third row."

Child: "You know a lot of them. I'll show you what numbers I did." (points out keys.) "Z,A,W and that one three times.

As this session illustrates, the computer allows for immediate feedback. The computer reinforces previously acquired concepts only if the child understands the concepts being used in the game.

Young children need to use the computer regularly and consistently in order to remember procedures. The children in the project who attended school only two days a week required more guidance and reminders than those who attended five days.

Having a computer in the classroom motivated parental interest in the program. A day was scheduled for all interested parents to visit and to let the children show them how to use the computer. Since some adults are threatened by new technology, this seemed to be a non-threatening way of introducing some adults to computers.

Some parents think a computer is absolutely necessary for the preschool child's education. In sometimes irresponsible ways, television commercials promote and reinforce this belief. Parents need to be aware of

the strengths and the weaknesses and limitations of computer use with young children; they should not be unduly swayed by pressures and unsupported claims that their children will be behind in school if they don't have a computer at home. Computers should be used in the classrooms only after teachers have carefully studied their values and their limitations. As has been emphasized, a decision to incorporate the computer into the preschool program is expensive in both equipment and teacher time. Decision-makers should be certain that the benefits outweigh the weaknesses. They should address this question: Does the computer achieve desired learning outcome as well as or better than other media or methods?

Computers in school have many potentially positive characteristics. They can help to foster small motor skills, to develop eye-hand coordination, and to give children a sense of control and competence. These features can be meaningful to the development of young children. For effective computer usage during the preschool years, a knowledgeable adult should be present to reinforce, clarify and explain procedures. Computers play a prominent, if not dominating role in our present culture, and thus should be part of the education of all children. But they should be used with young children only after thoughtful, careful consideration and after a study of available evidence regarding their effectiveness.

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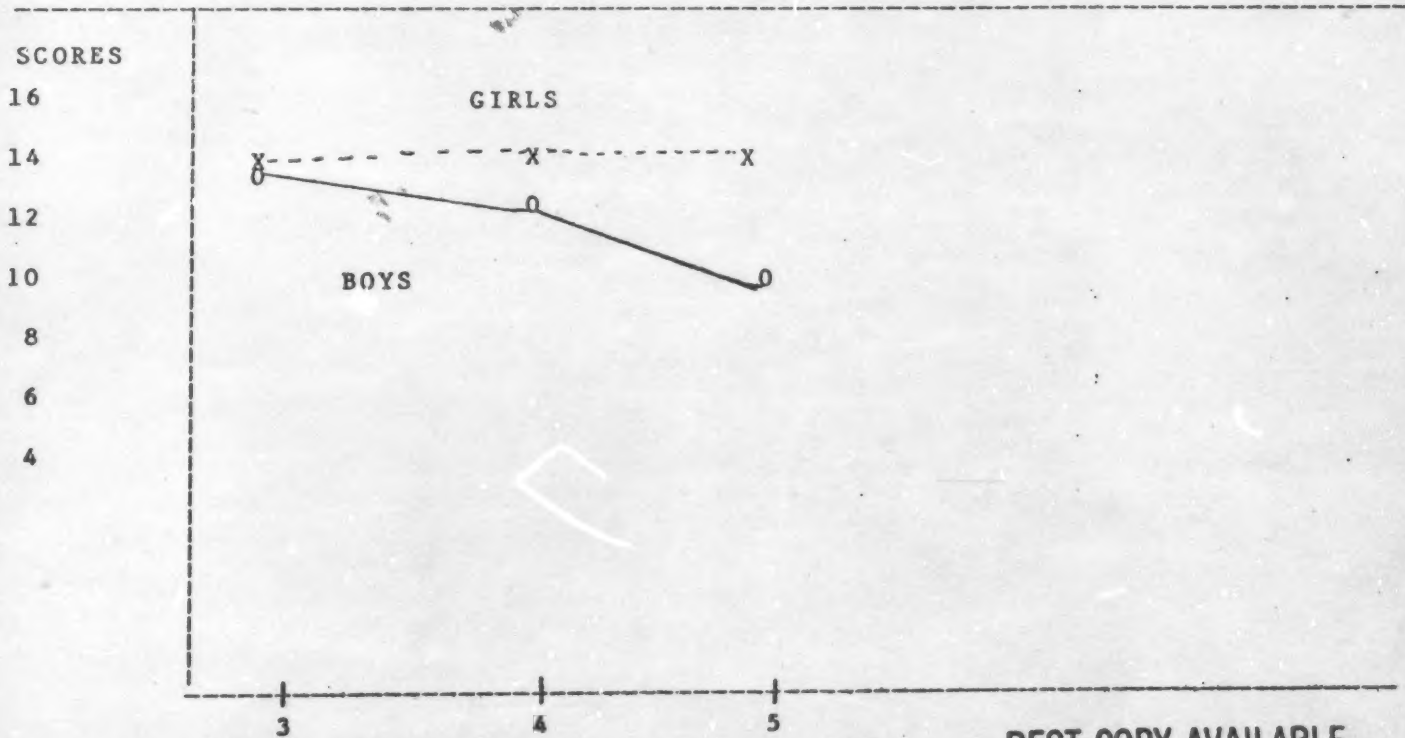
CHART 1

PROGRAM INTEREST
Category Scores

	3 year olds*		4 year olds*		5 year olds*	
	Boys	Girls	Boys	Girls	Boys	Girls
Md	15	15	15	15	8	15
$\bar{x}$	14.43	14.82	13.462	15.00	8.50	15.00
SD	0.976	0.603	2.184	0.000	1.915	0.000
n	7	11	13	21	4	3
			$X^2(1)=7.059$			
			P .01		P=.0571, Fischer Exact Test	

OVERALL BOYS vs. GIRLS X^2 (1) = 14.584, P less than .001

GRAPH 1
Program Interest Category



*Ages as of October, 1983

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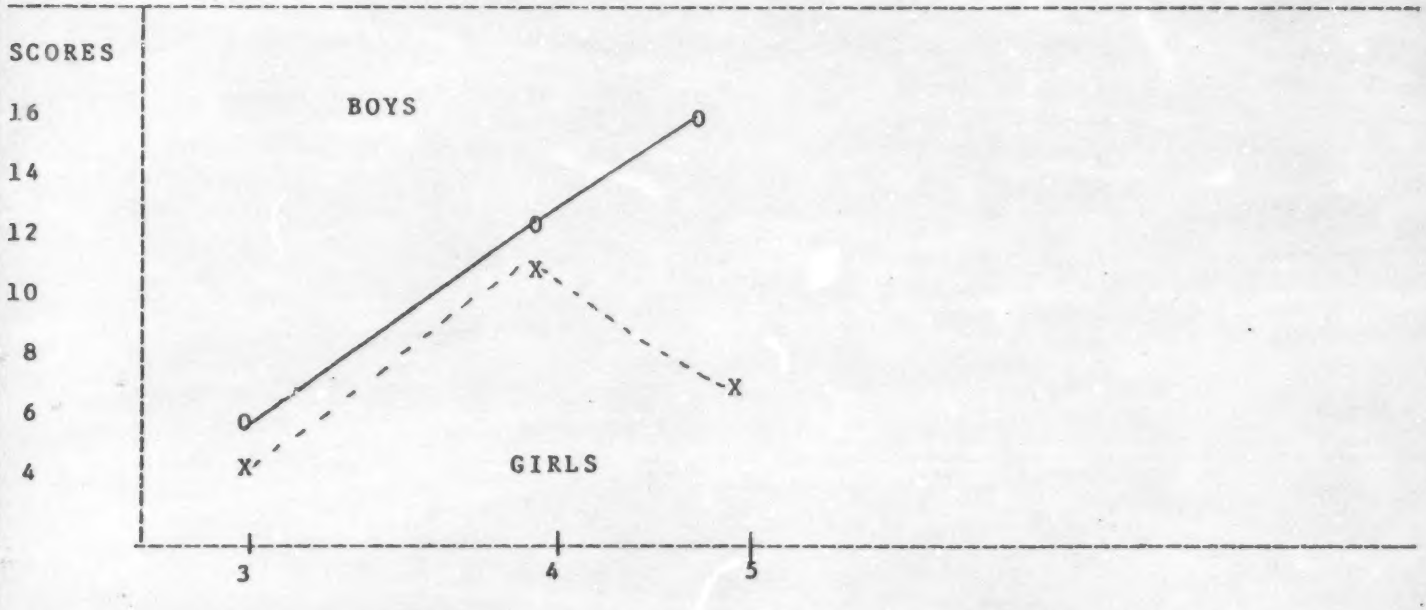
ROBOT USE AND SCREEN TURTLE CATEGORY SCORES

	3 year olds*		4 year olds*		5 year olds*	
	Boys	Girls	Boys	Girls	Boys	Girls
Md	5	5	12	10	17	5
$\bar{x}$	6.000	5.455	12.231	10.950	16.50	7.33
SD	3.915	5.946	5.946	6.219	4.123	4.04
n	7	11	13	21	4	3

GRAPH 2
ROBOT USE AND SCREEN TURTLE CATEGORY SCORES



*Ages as of October, 1983

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